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ABSTRACT

Wait time, or the pauses between questions and responses, has been demonstrated to be an important factor influencing classroom learning. This paper reviews the key variables that have emerged in wait time research over the past 20 years. Progress in defining and measuring wait time has resulted in improved methodology for wait time research. Teacher training procedures have been improved through the use of several techniques, including modeling, pause feedback teaching aids, and strategies for modification of traditional classroom recitations, which lead to inquiry-based guided discussions and interactional dialogue patterns. Further research is needed to measure the effects of pauses and interaction patterns on affective transactions in the classroom. Research linking wait time variables with achievement outcomes is also needed. (GDC)

A SYMPOSIUM ON WAIT TIME

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of New York
at Oswego

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THE IDENTIFICATION, DEFINITION, AND MEASUREMENT OF KEY VARIABLES IN WAIT TIME RESEARCH

by

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The Indentification, Definition, and Measurement of Key Variables in Wait Time Research

The term wait time first surfaced in research on classroom interaction conducted by Lake (1973), Fowler (1973), Koran (1974), and Rowe (1974). These initial studies focused on the effects of pauses between questions and responses on cognitive outcome variables in the classroom. The measurement of these variables had been conceptualized earlier through the efforts of Bloom (1956). The analysis of cognitive learning levels in classroom interaction was later developed by Aschner and Gallagher (1970). Blosser (1973) was responsible for the creation of a question analysis system for science teaching. More recent work by DeTure (1979), Tobin (1979), Swift and Gooding (1983), and others (Marsh, 1978; Riley, 1980) has built upon those landmark studies.

Research conducted over the past 20 years on the subject of wait time has resulted in clarification of the effects of increased wait time duration. These studies have also created a plethora of terms for the variables that have been examined. The purpose of this paper is to enumerate and define these key terms, including both input and output variables, and to address the research points that emerge.

Of the many variables to be considered in this report, the primary independent or input variables focus on wait time pauses in classroom dialogue. The major dependent variables to be examined are the cognitive and affective outcomes of academic performance and quality of life in the classroom as demonstrated

by achievement and interest or satisfaction on the part of teachers and their students. The other variables to be noted derive their importance through their assumed and/or tested relationship to the primary independent and dependent variables.

Wait Time

Numerous researchers have shown that it is possible to train teachers to moderate the pace of interactive speech and to allow more time for students to initiate and complete their verbal statements in a classroom. Representative of these are: DeTure (1979), Fowler (1974), Fagan, Hassler, and Szabo (1981), Rowe (1974), Tobin (1979), and Swift and Gooding (1983). On the other hand, DeTure also discovered that it is difficult for teachers to maintain pausing patterns once these have been established through training, observation, and feedback. In addition Tobin found that teachers need to modify their strategies in order to achieve the most beneficial effects of moderated pacing. That is, a class that is conducted as a memory level drill or recitation activity will not benefit to any great extent from extended wait times. It is necessary for the teacher to move to consideration of points that are higher on the taxonomy of learning, where additional thinking time will be of importance to the students.

Wait Time Training.

A significant breakthrough in wait time training came with the invention of a Wait Timer (TM), by J. N. Swift. This electronic device signals teachers and students when appropriate pauses have been observed, and has been shown to be highly effective in training both teachers and students to pause and in helping to

maintain appropriate wait time after initial training has been completed. The results of using this device were first reported a a meeting of the National Association for Research in Science Teaching (Swift & Gooding, 1982). The Wait Timer has undergone further field trials. Thought Technologies Ltd. has contracted to produce these classroom teaching aids, making them available to schools for professional development and as learning aids.

Wait Time Measurement

While training teachers and their students to pause has proven difficult, the accurate measurement of wait time has also presented serious problems for researchers. Initial studies of pauses in human dialogue were seriously hampered by the lack of appropriate instrumentation. Some early researchers attempted to use stop watches to measure pauses, but reaction time differentials caused serious reliability problems. Rectifier devices were also used, but Goldman-Eisler (1968) reported that this type of instrumentation was inadequate for reliable monitoring of speech pauses. Shortly thereafter, she noted that progress had been made in resolving reliability problems through the utilization of a decade counter (Hewlett-Packard AC-4A/B) and a digital recorder (Hewlett-Packard 560A). Rowe (1974) and others have used servo-chart plotters to more accurately measure wait times. We have found this technique to be difficult to use, since it requires the operator to estimate when each pause begins, and to convert linear measurements into time durations. Until very recently the most reliable wait time measurements were available only through application of high cost instrumentation such as the Bruel and Kjaer audio-frequency spectrometer

(O'Connell & Kowal, 1981). Even that sophisticated apparatus requires laborious and time-consuming hand recording of data.

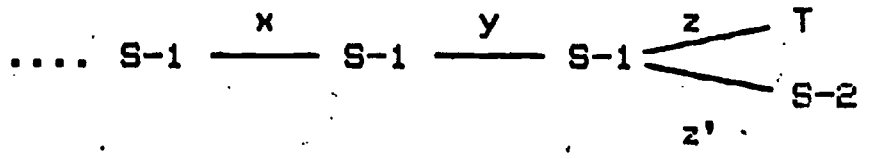
Because of these problems several researchers began to experiment with microcomputer based pause measurement procedures. McDougal (1979) analyzed data by using a KIM-1 to measure voice-space and wait time from audio tapes. This procedure facilitated the measurement of pauses, but was not operator interactive and called for manual recording of all wait times, a source of possible error. A further refinement was developed by Gooding, Gooding, and Swift (1982). Their device enables the measurement of wait times precise to .01 s at less cost than previous technology. It consists of analog hardware and digital computer hardware and software. A printout of pauses in dialogue is provided as the analysis proceeds. Successful use of this apparatus was reported by Swift and Gooding (1983) in a wait time study.

Wait Time Definitions.

Unfortunately, some confusion exists when different people use the term wait time. The verbal moves possible in classrooms are displayed on the next page, in Figure 1. In viewing the figure, Teacher Initiated Pauses (I) describe a teacher (T) who speaks, then pauses (d), speaks again and pauses (c), speaks again and perhaps asks a question, pauses (b) and calls upon a student (N). The student responds after a pause (a). In our work, wait time 1 is defined as the length of pause b plus the length of pause a, if it is present.

I. Teacher Initiated Pauses

II. Student Initiated Pauses



where: T = Teacher
S, S-1, S-2 = Students
N = Nomination
a, b, c, d, x, y, z, z' = Pauses

Figure 1. Classroom Verbal Moves

Student Initiated Pauses (II) describe a student (S-1) who either responds to a question or volunteers information, pauses (x), continues, then pauses (y). At this time, either the teacher (T) can respond after a pause (z), or another student can respond (S-2). We label pause z as wait time 2. Since pause z' seems to be of a different nature than pause z (apparently, students feel quite free to interrupt each other), we call these pauses wait time 3 when there is student-student interaction.

As can be seen from the large number of possible combinations of these pauses, it is important for all researchers to clearly specify the components of wait times. For example, if some investigators include y and others do not, or others use differert labels for the same interval, then it is difficult to draw conclusions confidently. We are indebted to Tobin and Capie (1981) who called for resolution of this important problem in the research literature.

Additional Independent Variables.

Other independent variables that researchers have considered in wait time research are training procedures, teacher and student personality variables, and environmental factors. These examples are illustrative and not intended to be exhaustive of all variables and authors.

Training procedures include strategies such as: audiotape and/or videotape feedback, microteaching, modeling, observational feedback, training materials, and readings. Practitioners who use these techniques include: DeTure (1979), Gooding, Swift, and Swift (1984), Koran (1974), Rowe, (1974), Swift and Gooding (1983), and Tobin (1979).

Teacher and student personality and intelligence variables encompass a variety of attributes: activity levels, attitudes, demographic differences, dogmatism, expectations, intelligence, locus of control, or fate control, student dialogue, and classroom climate. Researchers who have focused on these variables include: Alves, Swift and Swift (1983), Andrus and Gooding (1983), DeTure (1979), Mitchell (1984), Rowe (1974), Schell (1983, 1984), and Tobin (1979).

Classroom environmental factors have not been systematically researched but have potential for further investigation. Several that we have identified are: noise levels, physical conditions, and seating patterns.

Wait Time Outcome Variables.

Tobin and Capie (1981) and Tobin (1984) have reviewed the effects of wait time on a variety of classroom outcomes. These

dependent variables include length of student responses, number of unsolicited responses, failures to respond, inflected responses, speculative responses, student-student comparisons of data, evidence-inference statements, incidence of student questions, incidence of responses from slower learners, variety in verbal behavior, teacher response flexibility, teacher expectations, and number and type of questions asked by the teacher. Subcategories and explanations of these variables are delineated in the reports cited above.

Of these, questioning level continues to be one of central concern. The choice of analysis systems for measurement of classroom questions is of importance. Those used in the past include: Aschner and Gallagher (1970), Bloom (1956), Blosser (1973), and Parsons (1971). Often these analysis categories are collapsed into lower and higher cognitive level questions. Statements or questions in the affective domain are rare.

The category systems all present difficulties. For example, it is difficult to obtain interrater consensus, although one's ability to defend a particular categorization improves with experience. We find Blosser's scheme most useful when categorizing questions, but it is not effective for analysis of statements or responses to questions. At present, we are evaluating a system that has been developed by Dillon (1982). It appears that it may effectively resolve these concerns.

The other central variable is that of achievement. Results have been summarized by Tobin (1984), Tobin and Capie (1981), and Wise and Okey (1983). All studies indicate that wait time produces either a positive effect on achievement or no effect.

None indicate a detrimental change.

Several research workers have become interested in the nature of teachers' replies to student answers. According to Aspy and Roebuck, the climate of most classes appear to be neutral much of the time (Rogers, 1983). This was confirmed by Andrus and Gooding (1983), when the tape recordings of middle school science discussions were analyzed for facilative teacher responses. This ubiquitous blandness was also found by Goodlad (1984) and Sadker and Sadker (1985).

There are times when neutrality in responses is desired. Rowe (1978) believes that certain types of neutral responses facilitate inquiry, whereas praise acts as a signal that the one correct answer has been given. exchanges since continued exploration of alternatives appears unnecessary to the students. Not all neutral comments have equal impact on classroom dialogue, yet until now no data coding procedure has been in place to account for such differences. We suggest that a method of resolving this coding problem would be to subcategorize neutral comments as either bland or encouraging. We have preliminary evidence that indicates that encouraging remarks do facilitate interaction greatly.

There are a number of measures indicative of classroom climate that can be evaluated by listening to tape recordings. The amount of time that students talk, compared to their teachers, is one such measure. Other information can be obtained from word counts, interruptions, derogatory comments, and disciplinary remarks.

Doerr (1984) evaluated the cognitive level of interaction in classrooms according to four Piagetian operational levels: early concrete, fully concrete, late concrete-transitional, and fully formal. Although no mention had been made of Piaget during the study, the interactive levels that teachers used moved toward the formal stage of development when 3 s wait times were observed.

Emerging Issues.

A meta-analysis of classroom variables influencing student performance by Wise and Okey (1983) revealed that wait time was the most important factor for increasing achievement. However, their analysis included only four wait time studies that measured achievement as an outcome variable. Clearly, additional evaluation is needed so that a more comprehensive data base will be available.

Another issue of importance is determining the types of lessons or size of groups that would benefit most from using extended wait times. It appears certain that recitations are not the best classroom situations in which to use 3 s wait times (Tobin, 1984). The difficulty here is that most teachers have been unable to clearly distinguish between recitations and discussions. Whereas the former are fact oriented and directly related to content, the latter may or not have content as the central focus. In discussions, questions and statements are often at the higher cognitive or feelings level, and should require the 3 s wait time.

A new variable that has shown promise as a factor in changing teacher wait time and related behavior is that of supportive intervention (Swift, Swift, & Gooding, 1985). Another

is the use of modeling protocols (DeTure, 1985). However, as Tobin (1985) has noted, extending wait times without modifying current instructional patterns will not result in the anticipated changes in learning that are possible. Interactions must move from the examination oriented, low cognitive level, quiz show pattern (Roby, 1983) to inquiry based transactions between teachers and their students. A comprehensive study of supportive intervention is now underway as part of a National Science Foundation funded project in the Classroom Interaction Research Laboratory at the State University of New York College at Oswego.

Summary.

Progress in defining and measuring wait time has resulted in improved methodology for wait time research. Meta-analysis and traditional literature reviews have demonstrated the importance of wait time as a major factor influencing classroom learning. Training procedures have been improved through the use of several techniques. Some of these are: modeling, pause feedback teaching aids, and strategies for modification of traditional classroom recitations leading to inquiry based guided discussions and interactional dialogue patterns.

For the future, more research is needed that will measure the effects of pauses and interaction patterns on affective transactions in the classroom. The cognitive domain still remains as a central concern. At a recent conference a school superintendent asked, "All of this [wait time research] is interesting, but what about achievement? Where is your

product?". A clear answer to this question is deserved It points to the necessity for further research linking the wait time variables with achievement outcomes.

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